

REMARKS

Claims 1-15 are pending. By this Amendment, Claims 16-38 have been canceled and Claims 1, 4, 5, 7, 9, 10 and 12 have been amended. Reconsideration of the December 5, 2002 Official Action is respectfully requested.

Claims 1-14 were rejected under 35 U.S.C. 103(a) over WO 00/41212 to Ni et al. ("Ni") in view of U.S. Patent No. 4,980,204 to Fuji et al. ("Fuji"). The reasons for the rejection are stated at pages 3 and 4 of the Official Action. The rejection is respectfully traversed.

Claim 1, as amended, recites a plasma processing system, which comprises, *inter alia*, the features of "a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber, the gas outlets being supplied process gas by a single gas supply" (emphasis added). Support for the amendments to Claim 1 can be found, for example, in original Claim 4 and at page 11, lines 4-6, of the specification. Ni and Fuji fail to suggest the combination of features recited in Claim 1 for the following reasons.

The Official Action asserts that Ni shows the invention substantially as claimed including a gas injector 22 "including a single on-axis outlet and a plurality of off-axis outlets in a side surface of the gas injector (see, for instance, Fig. 3A)". The Official Action acknowledges that Ni "fails to expressly disclose the gas injector including a plurality of gas outlets supplying gas at flow rates that are independently varied between at

least some of the outlets in the injector, specifically, between the on-axis and off-axis outlets".

However, the Official Action asserts that Fuji discloses using independent outlets 111, 112, 113, 114 that are independently varied between gas flow control valves 13, 14, 15, 16 and come from a main outlet 20. It is further asserted in the Official Action that it would have been obvious to one having ordinary skill in the art to have modified Ni's apparatus to include independent flow control for each outlet of the injector as allegedly suggested by Fuji. Applicants respectfully disagree with these assertions for the following reasons.

Claim 1 recites a gas injector "including a plurality of gas outlets", i.e., a single gas injector that includes a plurality of gas outlets. Fuji does not suggest such gas injector, but rather discloses a plurality of separate vent pipes 111, 112, 113, 114, each vent pipe including a spouting end 108 through which gas is introduced into the reactor chamber 5. Fuji clearly does not suggest a single injector that includes a plurality of gas outlets.

Accordingly, Fuji cannot suggest the feature of "the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber" (emphasis added), as recited in Claim 1.

Thus, Fuji provides no motivation to modify Ni to attempt to achieve the plasma processing system recited in Claim 1. Moreover, even if Ni and Fuji were improperly combined, the resulting combination would not include each and every feature recited in Claim 1. As explained at MPEP § 2143, page 2100-122, "the prior art reference (or

references when combined) must teach or suggest all the claim limitations" in order to establish a *prima facie* of obviousness. Accordingly, the rejection fails to meet this requirement.

Accordingly, the combination of features recited in Claim 1 is patentable over Ni and Fuji. Dependent Claims 2-6 and 11-15 also are patentable over Ni and Fuji for at least the same reasons as Claim 1.

Claim 7 has been rewritten in independent form and recites a plasma processing system, which comprises, *inter alia*, "a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a planar axial end face having an on-axis outlet therein and a conical side surface having off-axis outlets therein, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage, the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber" (emphasis added). Ni and Fuji fail to suggest the plasma processing system recited in Claim 7 for the following reasons.

As acknowledged in the Official Action, Ni fails to suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently varied between at least some of the outlets in the injector, specifically, between the on-axis and off-axis outlets". In addition to this omission, the gas injector 22 shown in Fig. 3A of Ni referred to in the Official Action includes central bore 44 and gas outlets 46 in fluid communication with the central bore. However, the gas outlets 46 are disposed at the same planar end

face. Ni does not suggest a conical surface having off-axis outlets therein, as recited in Claim 7. Ni also does not suggest the feature of "the off-axis outlets receiving process gas from an annular passage surrounding the central passage", as recited in Claim 7.

Fuji fails to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 7. Fuji does not suggest a single injector that includes a plurality of gas outlets. Accordingly, Fuji does not suggest a gas injector including an on-axis outlet and off-axis outlets, as recited in Claim 7. Fuji does not suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber", as recited in Claim 7. Accordingly, Ni and Fuji also fail to suggest the combination of features recited in Claim 7.

Thus, the combination of features recited in Claim 7 also is patentable over Ni and Fuji. Dependent Claim 8 also is patentable over Ni and Fuji for at least the same reasons as Claim 7.

Claim 9 also has been rewritten in independent form and recites a plasma processing system, which comprises, *inter alia*, "a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including at least one on-axis outlet which injects process gas in an axial direction perpendicular to a plane parallel to an exposed surface of the substrate and off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate, the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing

chamber" (emphasis added). Ni and Fuji fail to suggest the plasma processing system recited in Claim 9 for the following reasons.

Ni fails to suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently varied between at least some of the outlets in the injector".

Fuji fails to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 9. Fuji does not suggest a single injector that includes a plurality of gas outlets, including an on-axis outlet and off-axis outlets, as recited in Claim 9. As such, Fuji cannot suggest the feature of "the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber", as recited in Claim 9. Accordingly, Ni and Fuji fail to suggest the combination of features recited in Claim 9, which is thus patentable over Ni and Fuji.

Claim 10 also has been rewritten in independent form and recites a plasma processing system, which comprises, *inter alia*, "a gas injector removably mounted in an opening in the dielectric member and extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, a vacuum seal being provided between the gas injector and the dielectric window, the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber" (emphasis added). Ni and Fuji fail to suggest the plasma processing system recited in Claim 10 for the following reasons.

Ni fails to suggest a gas injector "including a plurality of gas outlets supplying gas at flow rates that are independently varied between at least some of the outlets in the injector".

Fuji fails to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 10. Fuji does not suggest a single injector that includes a plurality of gas outlets. Accordingly, Fuji cannot suggest the feature of "the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber", as recited in Claim 10. Accordingly, Ni and Fuji fail to suggest the combination of features recited in Claim 10, which is thus patentable over Ni and Fuji.

Therefore, withdrawal of the rejection is respectfully requested.

Claim 15 was rejected under 35 U.S.C. 103(a) over Ni in view of Fuji and further in view of U.S. Patent No. 6,287,643 to Powell et al. The reasons for the rejection are stated at pages 4 and 5 of the Official Action. The rejection is respectfully traversed.

Powell also fails to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 1, from which Claim 15 depends. Accordingly, the combination of features recited in Claim 15 also is patentable.

Therefore, withdrawal of the rejection is respectfully requested.

Claim 1-14 were rejected under 35 U.S.C. 103(a) over Ni in view of U.S. Patent No. 5,160,543 to Ishihara et al. ("Ishihara"). The reasons for the rejection are stated at pages 5 and 6 of the Official Action. The rejection is respectfully traversed.

Ni and Ishihara fail to suggest the combinations of features recited in Claims 1-14 for the following reasons.

The Official Action asserted that Ishihara discloses using independent "outlets" 309, 310 that are independently varied between gas flow control valves 301d, 302d, 303d, 304d, 305d. It is further asserted in the Official Action that it would have been obvious to one having ordinary skill in the art to have modified Ni's apparatus to include independent flow control for each outlet of the injector, as allegedly suggested by Ishihara. Applicants respectfully disagree with these assertions for the following reasons.

Ishihara's apparatus depicted in Fig. 3 includes gas introducing pipes 309, 310 and a gas meeting space 306. The Official Action asserts that the gas introducing pipes 309, 310 are "outlets" of Ishihara's injector. Gas is supplied to the gas introducing pipe 309 via gas feeding pipeline 323, which is supplied gas from gas bombs 301, 302, and gas is supplied to the gas introducing pipe 310 via gas feeding pipeline 324, which is supplied gas from gas bombs 303-305. Accordingly, the gas introducing pipes 309, 310 are respectively supplied gas from different gas supplies. Thus, Ishihara does not suggest the feature of "the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber, the gas outlets being supplied process gas by a single gas supply", as recited in Claim 1.

Thus, Ishihara provides no motivation to modify Ni to attempt to achieve the plasma processing system recited in Claim 1. Furthermore, even if Ni and Ishihara were improperly combined, the resulting combination would not include each and every feature

recited in Claim 1. Thus, the Official Action has not established a *prima facie* case of obviousness.

Accordingly, the combination of features recited in Claim 1 is patentable over Ni and Ishihara. Dependent Claims 2-6 and 11-15 also are patentable over Ni and Ishihara for at least the same reasons as Claim 1.

Regarding Claim 7, neither Ni nor Ishihara suggests the features of "the gas injector including a planar axial end face having an on-axis outlet therein and a conical side surface having off-axis outlets therein, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage, the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber" (emphasis added).

Thus, the combination of features recited in Claim 7 also is patentable over Ni and Ishihara. Dependent Claim 8 also is patentable over Ni and Ishihara for at least the same reasons as Claim 7.

Regarding Claim 9, Ni and Ishihara fail to suggest the features of "a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including at least one on-axis outlet which injects process gas in an axial direction perpendicular to a plane parallel to an exposed surface of the substrate and off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate, the gas injector supplying process gas at flow rates that are independently varied between at least some of

the outlets into the processing chamber" (emphasis added). As explained above, Ni does not suggest a gas injector "supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber", as recited in Claim 9.

The apparatus depicted in Fig. 3 of Ishihara includes gas introducing pipe 309 having an on-axis gas outlet at its bottom end, and introducing pipe 310 having an on-axis gas outlet at its bottom end, which is co-axial with the gas outlet of the gas introducing pipe 309. Ishihara's apparatus does not include off-axis gas outlets, as recited in Claim 9. Furthermore, the gas outlets of the gas introducing pipes 309, 310 inject gas in the same axial direction. Thus, the gas introducing pipes 309, 310 do not include "off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate" (emphasis added), as recited in Claim 9.

Thus, the combination of features recited in Claim 9 also is patentable over Ni and Ishihara.

Claim 10 recites the features of "a gas injector removably mounted in an opening in the dielectric member and extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, a vacuum seal being provided between the gas injector and the dielectric window, the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber" (emphasis added). Ni and Ishihara fail to suggest the plasma processing system recited in Claim 10 for the following reasons.

Neither Ni nor Ishihara suggests the features of "the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied

between at least some of the outlets into the processing chamber" (emphasis added).

Namely, the apparatus shown in Fig. 3 of Ishihara includes gas introducing pipes 309, 310 which inject gas via the same meeting space 306 of the gas introducing port 311 into the vacuum chamber 220. Ishihara discloses that within the meeting space, gases come in chemical contact with each other and form precursors, which flow against the substrate to form a film thereon (paragraph bridging cols. 6 and 7). Accordingly, Ishihara does not disclose supplying process gas at independently varied flow rates between at least some outlets into the vacuum chamber 220.

Accordingly, Ni and Ishihara fail to suggest the combination of features recited in Claim 10, which is thus patentable over Ni and Ishihara.

Therefore, withdrawal of the rejection is respectfully requested.

Claim 15 was rejected under 35 U.S.C. 103(a) over Ni in view of Ishihara and further in view of Powell. The reasons for the rejection are stated at pages 6 and 7 of the Official Action. This rejection is respectfully traversed.

Powell also fails to cure the deficiencies of Ni with respect to the plasma processing system recited in Claim 1, from which Claim 15 depends. Accordingly, the combination of features recited in Claim 15 also is patentable.

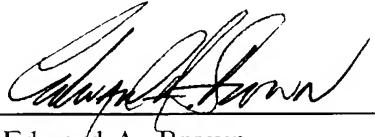
Therefore, withdrawal of the rejection is respectfully requested.

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For the foregoing reasons, withdrawal of the rejections and prompt allowance of the application are respectfully requested.

Respectfully submitted,

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Date: January 24, 2003



Attachment to Amendment dated January 24, 2003

Mark-up of Claims 1, 4, 5, 7, 9, 10 and 12

1. (Amended) A plasma processing system comprising:
 - a plasma processing chamber;
 - a vacuum pump connected to the processing chamber;
 - a substrate support on which a substrate is processed within the processing chamber;
 - a dielectric member having an interior surface facing the substrate support, wherein the dielectric member forms a wall of the processing chamber;
 - a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets supplying process gas at flow rates that are independently varied between at least some of the outlets into the processing chamber, the gas outlets being supplied process gas by a single gas supply; and
 - an RF energy source which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.

4. (Amended) The system of Claim 1, wherein the gas outlets include a single on-axis outlet in an axial end surface of the gas injector and a plurality of off-axis outlets in a side surface of the gas injector, the on-axis outlet and the off-axis outlets being supplied process gas from [a] the single gas supply via first and second gas lines, the gas lines

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including flow controllers which provide adjustable gas flow to the on-axis outlet independently of the off-axis outlets.

5. (Amended) The system of Claim 1, wherein the gas outlets include a center gas outlet extending in an axial direction perpendicular to the exposed surface of the substrate and a plurality of angled gas outlets extending at an acute angle to the axial direction, the center gas outlet receiving process gas supplied by a first gas line and the angled gas outlets receiving process gas from a second gas line, the first and second gas lines receiving process gas from the [same] single gas supply.

7. (Amended) [The system of Claim 1, wherein the gas injector includes a planar axial end face having an on-axis outlet therein and a conical side surface having off-axis outlets therein, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage.] A plasma processing system comprising:

a plasma processing chamber;

a vacuum pump connected to the processing chamber;

a substrate support on which a substrate is processed within the processing chamber;

a dielectric member having an interior surface facing the substrate support,
wherein the dielectric member forms a wall of the processing chamber;

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a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a planar axial end face having an on-axis outlet therein and a conical side surface having off-axis outlets therein, the on-axis outlet receiving process gas from a central passage in the injector and the off-axis outlets receiving process gas from an annular passage surrounding the central passage, the gas injector supplying process gas at flow rates that are independently varied between at least some of the outlets including the on-axis outlet into the processing chamber; and

an RF energy source which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.

9. (Amended) [The system of Claim 1, wherein the gas injector includes at least one on-axis outlet which injects process gas in an axial direction perpendicular to a plane parallel to an exposed surface of the substrate and off-axis gas outlets which inject process gas at an acute angle relative to the plane parallel to the exposed surface of the substrate.] A plasma processing system comprising:

a plasma processing chamber;
a vacuum pump connected to the processing chamber;
a substrate support on which a substrate is processed within the processing chamber;

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a dielectric member having an interior surface facing the substrate support,
wherein the dielectric member forms a wall of the processing chamber;

a gas injector extending through the dielectric member such that a distal end
of the gas injector is exposed within the processing chamber, the gas injector including at
least one on-axis outlet which injects process gas in an axial direction perpendicular to a
plane parallel to an exposed surface of the substrate and off-axis gas outlets which inject
process gas at an acute angle relative to the plane parallel to the exposed surface of the
substrate, the gas injector supplying process gas at flow rates that are independently varied
between at least some of the outlets into the processing chamber; and

an RF energy source which inductively couples RF energy through the
dielectric member and into the chamber to energize the process gas into a plasma state to
process the substrate.

10. (Amended) [The system of Claim 1, wherein the gas injector is removably mounted in the opening in the dielectric window and a vacuum seal is provided between the gas injector and the dielectric window.] A plasma processing system comprising:
a plasma processing chamber;
a vacuum pump connected to the processing chamber;
a substrate support on which a substrate is processed within the processing
chamber;

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a dielectric member having an interior surface facing the substrate support,
wherein the dielectric member forms a wall of the processing chamber;

a gas injector removably mounted in an opening in the dielectric member and
extending through the dielectric member such that a distal end of the gas injector is exposed
within the processing chamber, a vacuum seal being provided between the gas injector and
the dielectric window, the gas injector including a plurality of gas outlets supplying process
gas at flow rates that are independently varied between at least some of the outlets into the
processing chamber; and

an RF energy source which inductively couples RF energy through the
dielectric member and into the chamber to energize the process gas into a plasma state to
process the substrate.

12. (Amended) The system of Claim 1, wherein [a] the single [main] gas supply
is split into multiple gas supply lines to feed the gas outlets.